AMMOTHEA VERENAE AND SERICOSURA VENTICOLA, TWO NEW HYDROTHERMAL VENT-ASSOCIATED PYCNOGONIDS FROM THE NORTHEAST PACIFIC

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Abstract. — Two new pycnogonid species, *Ammothea verenae* and *Sericosura venticola,* are described from hydrothermal vents on the Juan de Fuca Ridge, northeast Pacific. These first known vent-associated pycnogonids are compared with previously known species of the two genera; their distribution, possible reasons for the evolution of this distribution among these and similar genera, and observable characters in the species' morphologies in relation to hydrothermal vents are discussed.

Continuing investigations of hydrothermal vents on tectonic rifts in the deep oceans during the last decade since their discovery have revealed a wealth of fauna new to science. It is not surprising that these intensive investigations should discover pycnogonids among the often unique fauna associated with these vents. The two species described here are new and are also the first pycnogonids to be found in association with hydrothermal vents. Specimens of both genera to which the new species belong have been taken before at similar depths and in diverse localities, but none have been reported from or found associated with tectonic rifts. Bottom photographs supplied with some of the specimens reported here plainly show pycnogonids and other rift fauna in close association with vents. Well over half the specimens listed in the following "Materials Examined" sections are partly covered with layers of polymetallic sulfides spewed out of nearby vents. Clearly, the pycnogonids and other vent fauna must have developed adaptive strategies to permit their living and proliferating in these seemingly transient areas of wide temperature and chemical variation. How this has been accomplished is beyond the scope of speculation in this paper, although a few observations on adaptation are offered in the discussion sec-

tion. It is sufficient to say in light of our present knowledge that they have adapted successfully with at least one of the new species found widespread along several hundred kilometers of the Juan de Fuca Ridge in vent temperatures at least as high as 85°C.

Family Ammotheidae
Genus *Ammothea* Leach, 1814
Ammothea verenae, new species
Fig. 1

Material examined. — ENDEAVOUR SEGMENT: vent at 47°57.1′N, 129°06.0′W, 2216 m, coll. DSRV *Alvin,* 2 Sep 1984, sta 1446-3-702, holotype male with eggs (USNM 233636), paratypes, 4 males with eggs, 1 male, 1 female (USNM 233637), paratypes, 5 males with eggs (NMC).— "TLC" Vent, 47°57.1′N, 129°06.3′W, 2250 m, coll. DSRV *Alvin,* 3 Sep 1984, sta A1446-719, paratype juvenile (USNM 233638).— Another vent near "TLC" Vent, same locality, 2199 m, coll. DSRV *Alvin,* 6 Sep 1984, sta A1451-706, paratypes, 1 male with eggs, 2 females, 1 juvenile (NMC).

Other material: EXPLORER RIDGE: Pogo Peaks Vent, 49°45.5′N, 130°16.2′W, 1853 m, coll. DSRV *Pisces IV,* 23 Jun 1984, sta P1492-714, 1 ♀, 1 juv (USNM), 1 ♀ ovig,

5 juv (NMC).—Magic Mountain, Gulati Gusher, 49°45′36″N, 130°16′07″W, 1818 m, coll. DSRV *Pisces IV*, 1 Jul 1984, sta P1494-703, 2 ♂, 4 ♀, 35 juv (UVBC).—Hottest vent (85°C), same locality, coll. DSRV *Pisces IV*, 1 Jul 1984, sta P1494-704, 1 ♂ (USNM).— Biomass sample, same locality, depth, and collector, 1 Jul 1984, sta P1494-718, 1 ♂, 9 ♀, 64 juv (USNM).—"Lunch Hour" Vent, same locality, collector, 1808 m, 2 Jul 1984, sta P1495-705, 1 ♂ with eggs, 1 ♂, 4 ♀, 28 juv (NMC).—Upper Magic Mountain, Crab Vent, 49°46′N, 130°18′W, 1780 m, coll. *Pisces IV*, 4 Jul 1984, sta P1494-701, 3 juv (USNM).—Same locality, collector, 1837 m, sta P1497-700, 4 Jul 1984, 3 ♂ with eggs, 1 ♂, 3 ♀, 8 juv (UVBC).—Busted Thruster Vent, 49°45.7′N, 130°16.1′W, 1823 m, coll. *Pisces IV*, 19 Aug 1984, sta P1505-717, 2 ♂ with eggs, 3 ♂, 4 ♀, 9 juv (UVBC), 2 ♂ with eggs, 1 ♀, 8 juv (USNM).

ENDEAVOUR SEGMENT: Juan de Fuca Ridge: vent at 47°57.0′N, 129°04.0′W, 2212 m, coll. DSRV *Alvin*, 24 Jul 1984, sta 1418, 1 ♀ (USNM).—Vent, associated with vestimentiferans, ca. 46°N, 130°W, ca. 2000 m, coll. DSRV *Alvin*, 25 Jul 1984, sta 1419, 1 ♀, 1 juv (USNM).
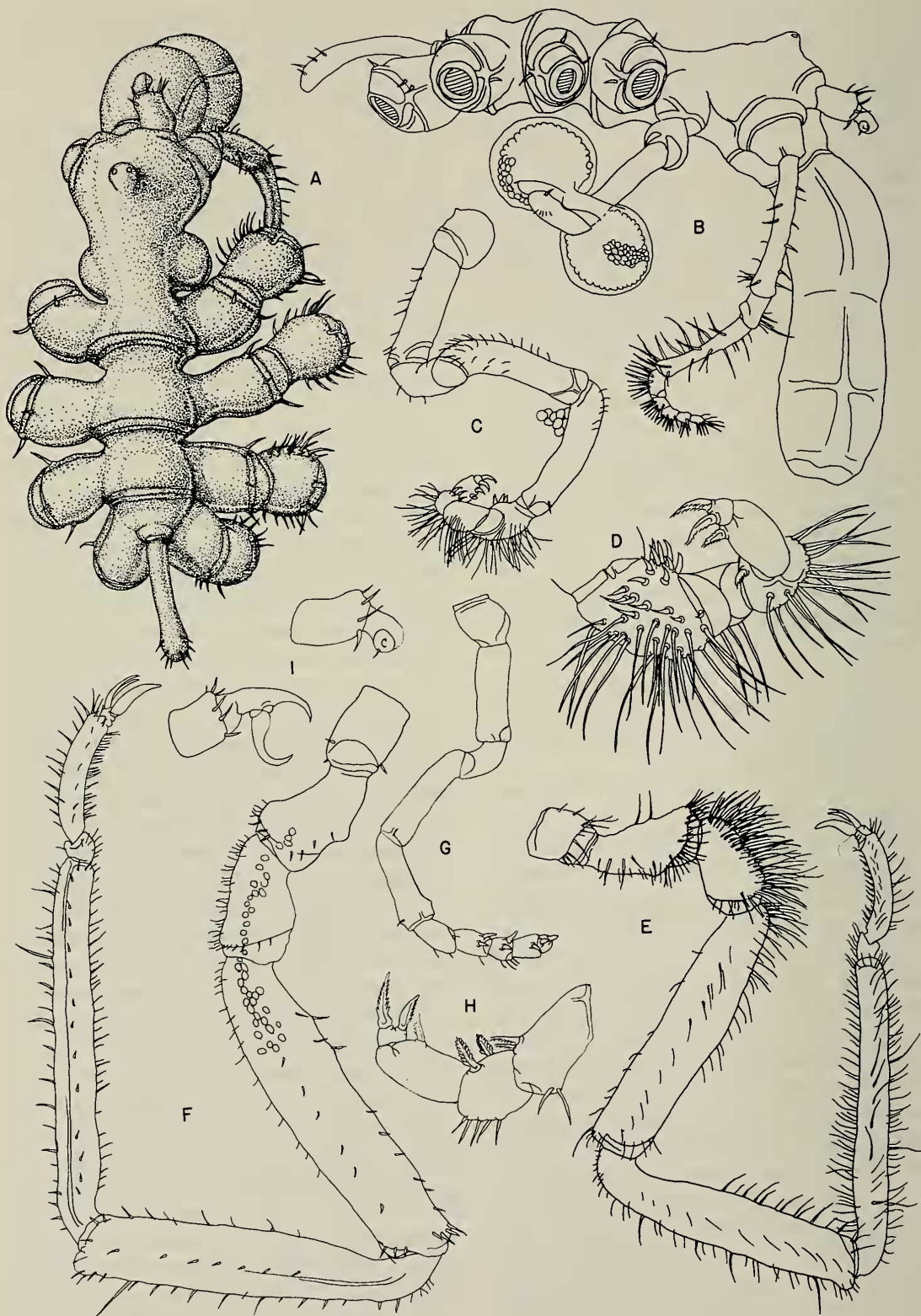
AXIAL SEAMOUNT: Devil Vent, near base of Hammond's Hell (60°C), 45°55.6′N, 130°01.8′W, 1570 m, coll. DSRV *Pisces IV*, 14 Jul 1986, sta P1720-710, 1 ♂ (USNM).— Hammond's Hell, same locality and depth, coll. *Pisces IV*, 19 Jul 1986, sta P1723-711, 1 ♀ ovig, 2 ♀ (USNM).—Inactive sulfide chimney near Embley's Inferno, same locality, depth, collector, sta P1725-712, 25 Jul 1986, 3 juv (NMC).—Demon Vent no. 1, same locality, depth, collector, sta P1728-709, 29 Jul 1986, 1 juv (USNM).—Not-So-Miserable Vent, near Holland's Hillock, same locality, depth, and collector, sta P1733-707, 3 Aug 1986, 2 ♂ with eggs, 1 ♂, 1 ♀, 4 juv (UVBC).—Miserable Vent, same locality, depth, and collector, sta P1733-708, 3 Aug 1986, 1 juv (USNM).—Vent, same locality, depth, and collector, sta P1733-713, 3 Aug 1986, 1 ♂ with eggs, 2 juv (USNM).

SOUTHERN JUAN DE FUCA RIDGE: vent 1, 44°39′15″N, 130°22′W, ca. 2225 m, coll. DSRV *Alvin*, 24 Oct 1984, sta A1463-7B-716, 2 ♀, 1 juv (USNM).

Description.—Male: size moderately large, leg span 43.4 mm. Integument smooth, without texture. Trunk moderately slender, posterior of each segment flared into expanded cowling, without tubercles. Neck greatly expanded anteriorly, glabrous. Ocular tubercle a low truncate cone, shorter than basal width, without eyes, lateral sensory papillae prominent. Ocular tubercle placed just anterior to midlength of expanded neck, over palp insertion. Oviger implantation posterior to neck expansion, at narrowest point, anterior to but almost touching first lateral processes. Lateral processes moderately crowded, separated by less than half their diameters, as long as 1.5 times their diameters, armed with single dorsodistal seta each and 1 or 2 laterodistal setae except at anterior and posterior extremities. Proboscis massive, as long as anterior 3 trunk segments, proximal half with distinct ventral bend, hint of tripartite segmentation lines present, mouth surface flat. Proboscis base a separate truncate cone segment about 0.15 as long as proboscis. Abdomen slender with slightly bulbous tip, as long as distal rim of first coxae on posterior legs, armed with several dorso- and laterodistal short setae.

Chelifore short, 2-segmented. Scape short, only twice as long as diameter, armed with few distal and lateral setae shorter than segment diameter. Chela vestigial, a short stump with hint of movable finger ventrally, armed with tiny ventral seta.

Palp 9-segmented, longer than proboscis, basal segment massive, 3 times wider than distal segments. Second segment longest, armed with few short setae increasing in numbers distally. Third segment as long as basal segment, slightly longer than fifth segment, armed with few dorsal setae, one longer than segment diameter. Fourth segment only 0.7 as long as second, armed with many ventral setae, most longer than seg-

ment diameter. Terminal 4 segments sub-equal in length, very setose ventrally, most setae longer than segment diameters.

Oviger segments 4 and 5 equal in length, slightly longer than second segment, each with many short proximal setae. Strigilis extremely setose; sixth segment with many long ectal setae and 8 plain short endal spines, seventh and eighth segments with corresponding ectal spines, fewer in number, ninth and tenth without setae. Terminal 4 segments with endal denticulate spines in the formula 1:1:1:2, each spine having many lateral serrations. Egg size less than half diameter of main oviger segments, carried in large ovoid clusters.

Legs moderately long, slender, extremely setose. First coxa with several lateral and ventral setae, some longer than segment diameter. Second coxa with fringe of many lateral and ventrodistal setae. Third coxa with ventral field of long closely spaced setae sufficient in numbers to hide ventral outline of segment. Femur armed with similar setae proximoventrally, decreasing in numbers distally, and line of shorter lateral and dorsal setae. Location of femoral cement gland pore not definitely established, but may be dorsodistal in fringe of setae or proximolaterally as pores along line of lateral setae. Second tibia longest segment, slightly longer than first tibia and femur which are subequal in length. Three major segments armed with lines of lateral, dorsal and ventral setae, some slightly longer than segment diameters. Propodus slender, moderately curved, without marked heel, sole with 11–13 narrow spines, flanked with short lateral setae fewer in numbers. Propodus shape and spination similar on all legs. Claw robust, well curved, about 0.4 as long as propodus, auxiliaries almost as long as main claw,

slender, well curved. Sexual pores on second coxae of posterior 2 pairs of legs only.

Female paratype: slightly larger in all measurements except for oviger which is smaller than that of male. Strigilis with 2–5 ectal short setae, without fields of setae, terminal 4 segments with denticulate spines in formula 2:2:1:2. Sexual pores on all second coxae ventrally. Juvenile chela small, with slender very curved fingers overlapping at tips when closed, without teeth.

Measurements. — Holotype, in mm: trunk length (insertion of chelifore to tip 4th lateral processes) 5.6; trunk width (across 2nd lateral processes) 3.12; proboscis length 4.5; abdomen length 1.72; third leg, coxa 1 0.78; coxa 2 1.75; coxa 3 1.39; femur 4.3; tibia 1 4.32; tibia 2 4.68; tarsus 0.52; propodus 1.76; claw 0.65.

Distribution. — Known from the type locality, Endeavour Segment on Juan de Fuca Ridge in 2199–2250 m, and from Axial Seamount and Explorer Ridge in 1570–2225 m, all on or in close proximity to hydrothermal vents.

Etymology. — This species is named for Dr. Verena Tunnicliffe, University of Victoria, Victoria, British Columbia, Canada, who collected and contributed most of the specimens listed here.

Remarks. — This new species can be easily separated from most *Ammothea* species because it lacks the large dorsomedian trunk tubercles on the cowls of each segment posterior that are present in most species and most prominent in males. It can be further separated from most other known species by its total lack of specialized or differentiated sole spines and by having all propodal shape and armature alike. It lacks the large heel spines of most species and the dissimilarity of anterior leg propodi from those of

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Fig. 1. *Ammothea verenae,* male holotype: A, Trunk, dorsal view; B, Trunk, lateral view; C, Oviger; D, Oviger strigilis, enlarged; E, Third leg. Female paratype: F, Third leg with ova; G, Oviger; H, Oviger strigilis, enlarged; I, Chela of adult and of juvenile.

posterior legs. *Ammothea hilgendorfi* (Böhm) and *A. spicula* Nakamura and Child are the only northern species without dorsomedian trunk processes although both have major heel spines differing from those of the sole, and *A. australiensis* Flynn appears to be the only southern species with no trunk processes, but it also has major heel spines. Therefore, this new species is the only one known with uniform sole spines and no trunk processes.

The new species has other distinguishing characters such as the distinctive large bent proboscis, the extremely setose legs of the male, the giant palp first segment, and a lack of eyes on the very low ocular tubercle. The latter character is shared by only one other known species in this genus, *A. profunda* Losina-Losinsky. Most species of the genus are found in shallower depths or at least at depths where some light penetrates to justify the retention of eyes.

This species is apparently very common, at least in the restricted depths of the northeast Pacific where its hydrothermal vent habitats occur. It has been taken at vents, on sulfide chimneys, and adjacent to vents spewing sulfide particles such that over half the specimens listed above have some part to most of their anatomy encased in solidified polymetallic sulfide crusts. Photographs taken at some of the vent habitats show lava forms and other large clastic shapes covered with these sulfides and having pycnogonids, limpets, galatheid crabs, worms (Polynoidae), and unidentified fauna inhabiting most surfaces in good numbers. Unlike most of the sparse records showing lack of thermal tolerance for pycnogonids, these specimens apparently survive a wide range of temperatures. Recorded temperatures around some of the vents list differences of 4°–5° above ambient at corresponding depths, but one capture of this species was made at the "hottest vent" sampled on Explorer Ridge (85°C). Another specimen was taken at "Devil Vent" on Axial Seamount at 60°C. It is difficult to imagine how such delicate animals can survive these temperatures unless mixing among bottom currents is such that cooling takes place almost instantly after exposure to temperatures such as those above.

Genus *Sericosura* Fry and Hedgpeth, 1969
Sericosura venticola, new species
Fig. 2

Material examined. —ENDEAVOUR SEGMENT: vent, associated with vestimentiferans, 47°57.0′N, 129°04.0′W, 2208 m, coll. DSRV *Alvin* 25 Jul 1984, sta 1419, holotype male with eggs (USNM 233639).— Vent, 47°57.1′N, 129°06.0′W, 2216 m, coll. DSRV *Alvin,* 2 Sep 1984, sta A1446-3-702, paratype male with eggs (USNM 233640), paratype male with eggs (NMC).

Description. —Size moderately large, leg span 27.6 mm. Integument smooth, without papillae or other texture. Trunk slender, graceful, posterior of anterior 3 trunk segments flared into cowl, without tubercles. Neck gradually expanded anteriorly, armed with pair of short setae on both anterolateral tips. Ocular tubercle slightly taller than basal diameter, without eyes, with prominent lateral sensory papillae, rounded at apex, placed just anterior to midlength of neck. Oviger implantation massive, at narrowest point of neck, posterior to ocular tubercle, almost touching first lateral processes. Lateral processes almost touching, separated by less than half their diameters, swollen distally to constricted bases, only slightly longer than maximum diameters, armed with 1–3 laterodistal setae, none longer than half segment diameter. Proboscis massive, ovoid, without ventral bend, carried horizontally, without trace of segmentation lines, almost as long as trunk, mouth surface flat. Abdomen slender, curved ventrally, tip swollen, extending to distal rim of second coxae of fourth legs, armed with 5–6 distal short setae, with distinct basal segmentation line.
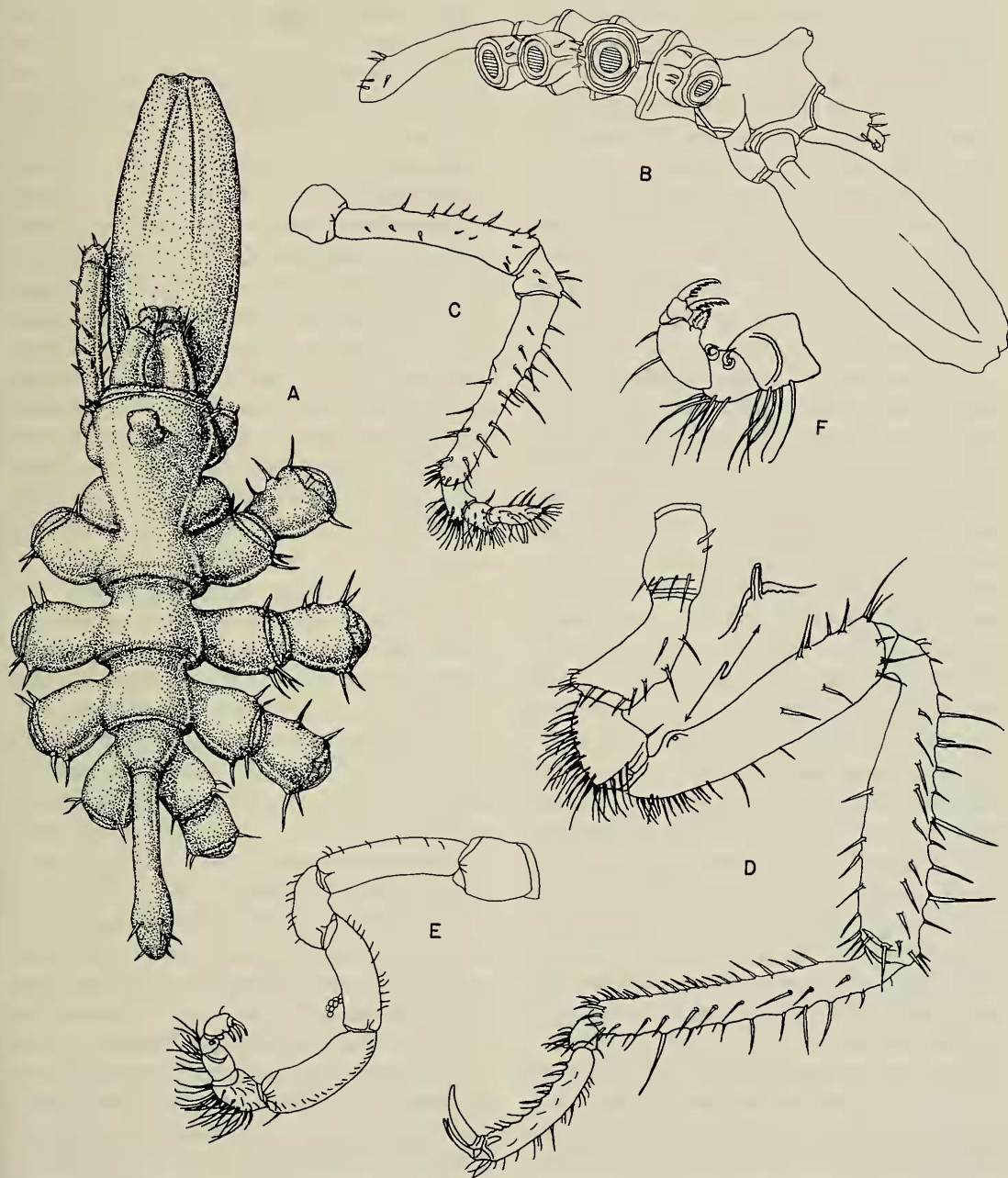
Chelifores short, 2-segmented. Scape twice

Fig. 2. *Sericosura venticola,* male holotype: A, Trunk, dorsal view; B, Trunk, lateral view; C, Palp; D, Third leg, with enlargement of cement gland; E, Oviger; F, Oviger strigilis, enlarged.

as long as diameter, slightly curved toward median line, armed distally with 3–4 short lateral setae. Chela tiny, vestigial, with only trace of movable finger, armed with single short distal seta.

Palp 7-segmented, heavily setose. Seg-ments 2 and 4 subequal, armed with many dorsal and lateral setae, most shorter than segment diameter. Segments 5 and 6 sub-equal, with slight ventral swelling, armed with dense setae mostly longer than seg-ments. Seventh segment cylindrical, as long

as fifth and sixth combined, armed with dense setae of same length as those on more proximal segments.

Oviger second segment longest, length 3.5 times diameter, fourth and fifth segments slightly shorter, subequal, all armed with row of very short ectal setae. Strigilis heavily setose, ectal setae longer than segment diameters, with endal denticulate spines in formula 0:2:1:2, spines with many lateral serrations. Extremely tiny eggs carried cemented into hollow balls.

Legs moderately long, segments slender, very setose. First coxa armed with 1–2 anterior setae and fringe of latero- and ventrodistal setae. Second coxa with several dorsal and lateral setae and fringe of distal setae. Third coxa with dense field of ventral and distal setae, many as long as segment diameter. Femur with dense fringe of proximoventral short setae and several longer lateral and dorsodistal setae. Cement gland almost at proximal margin of femur, with low surface bulge and very short tube pointing anteriorly on each leg. Tube not visible from posterior surface. First tibia longest segment, femur and second tibia slightly shorter, equal in length. Tibiae armed with many lateral, dorsal and ventral setae, mostly in rows, few on dorsal surface longer than segment diameter. Tarsus short, armed with single dorsal and 5–6 ventral setae. Propodus moderately curved, without heel or larger heel spines, sole with 10–12 spines not longer than segment diameter. Propodus armed with short lateral and dorsal setae. Claw moderately curved, slightly over 0.3 length of propodus, auxiliary claws very slender, 0.7 as long as main claw. Sexual pores ventrodistal on second coxae of posterior 4 legs.

Female and juvenile characters unknown.

Measurements.—Holotype, in mm: Trunk length (chelifore insertion to tip 4th lateral processes) 3.58; trunk width (across 2nd lateral processes) 2.3; proboscis length 3.09; abdomen length 1.55; third leg, coxa 1 0.78; coxa 2 1.1; coxa 3 0.82; femur 2.58; tibia

1 2.74; tibia 2 2.58; tarsus 0.25; propodus 1.34; claw 0.48.

Distribution.—Known from the type locality only, the Endeavour Segment in 2208–2216 m.

Etymology.—The specific name refers to a vent dweller.

Remarks.—This new species is very similar to the other known species of the genus, *S. mitrata.* The differences are in a more slender and longer habitus of the entire animal in *S. venticola,* and its very different arrangement of appendage setae. The setae arrangement and number are dimorphic in both species, but the female of *S. mitrata* has a ventral fringe of long hair-like setae and many short setae on the tibiae. The male (Child 1982:19–20, fig. 6c), unlike *S. venticola,* has no such field of ventral setae and has fewer setae on any leg segment. In *S. venticola,* the female is unknown, but the male has a dense field of long setae on the ventral surface of the third coxae and the adjacent proximal surface of the femur. The other leg segments are quite setose and it is probably safe to predict that the legs of the female will have very different setation based on *S. mitrata.*

Other differences are found in the much shorter cement gland tube of *S. venticola,* its longer and more slender chelifores, a tarsus and propodus with many more sole spines and setae, its longer and more setose palp segments, and its lack of any of the very long lateral leg setae present on *S. mitrata.* The ovigers of both species are remarkably similar except that the strigilis of *S. venticola* has more setae. Although of little taxonomic value as a critical character, the leg span of the new species is more than twice that of *S. mitrata,* although the trunk lengths are more nearly alike.

There are only six known specimens, including the above three males, reported for this apparently rare genus. The other known species, *S. mitrata,* has been taken along the African side of the Antarctic coast in 219 m (Gordon 1944:54–57, as *Achelia mitra-*

ta), and on the Walvis Ridge in 2117–2154 m (Child 1982:19–21). There were no hydrothermally active localities mentioned at the Walvis Ridge collecting site, but their presence cannot be ruled out. The depth here almost coincides with the capture depths of the new species. Gordon described the blind *S. mitrata* from a single female specimen and remarked on the apparent anomaly of blindness versus the relatively shallow depth of capture. This could be related to net contamination from a previous deeper haul, but Fry and Hedgpeth (1969:112–113) comment on the same depth discrepancies of several other blind shallow Antarctic species, making them skeptical of such anomalies, particularly in cold Antarctic waters.

Discussion

The two new species, *Ammothea verenae* and *Sericosura venticola,* belong to previously known genera. The genus *Ammothea* Leach, 1814, contains about 23 species, none of which are known to be vent-specific, and most of which are found in the Antarctic, Subantarctic, or at least in the Southern Hemisphere. Of the 23 species, only four are found partly or exclusively in the Northern Hemisphere, all in the northern Pacific, suggesting that the genus had its origins and proliferation in Antarctic waters and has subsequently spread northward. All north Pacific species, *Ammothea hedgpethi* (Utinomi) (Japan), *A. hilgendorfi* (Böhm) (Pan-Pacific), *A. profunda* Losina-Losinsky (Kuril Islands), and *A. spicula* Nakamura and Child (Japan), have been collected in shallow depths (less than 200 m) except *A. profunda* which was taken in 1500 m. Fry and Hedgpeth (1969:94) suggest that this species "has spread into the Northern Hemisphere by way of the cold abyssal or hadal regions." This certainly might account for the spread of *Ammothea verenae,* at least to the northeast Pacific from elsewhere, but would not explain its spread along hydrothermal rifts

and ridges, its only known habitat. This suggests a later adaptation to hydrothermal vent life after evolving first in northern Pacific areas. A cold abyssal distribution would also not explain the shallow and shore proliferation of *A. hilgendorfi,* principally around the rim of the northern Pacific, and presumably the presence of the two Japanese shallow-water species. *Ammothea hilgendorfi* must be a very long time resident of northern Pacific waters due to its extensive distribution from the Russian Arctic and China to the Society Islands and California.

There is one record of *A. hilgendorfi* from England, but a better north Atlantic counterpart to the Pacific species would be *Trygaeus communis* Dohrn. This genus probably split off from the parent *Ammothea* stock quite early, possibly from a species very much like *A. hilgendorfi, A. magniceps* Thomson, or *A. australiensis* Flynn, all of which are closely related and are superficially very much like *T. communis.* In becoming *Trygaeus,* the species discarded all trace of atrophied chelae while retaining the chelifore stump, and lost an oviger segment and a palp segment or two (the numbers vary among specimens). It shows a marked Tethyan distribution across the width of the Mediterranean.

Sericosura is another genus even more closely related to *Ammothea,* and it is probably not hydrothermal vent-specific. The second published record of *S. mitrata* (Child 1982:19–21, fig. 6) places it in much deeper water than the type (219 m versus 2100 m) and further north on the Walvis Ridge, a transverse oceanic ridge between continents said to be seismically inactive (Marvin 1973: 134) and distant from any locus of tectonic plate spreading.

The two new species of *Sericosura* and *Ammothea* described here appear superficially to be very similar when the ovigers, coxae setation, trunk habitus, and trunk-proboscis size are compared. In *Sericosura,* as in the genus *Trygaeus,* another genus has evolved with the secondary loss of appen-

dage segments. *Sericosura* has seven palp segments while *Ammothea* has nine (sometimes eight), and the former genus has lost its eyes (unnecessary in deep water) in contrast to eyes being present in most of the *Ammothea* species, or at least those from shallow water. The terminal palp segment of *Sericosura* is elongate and it probably coalesced from two former segments while losing another from the original nine. The loss (or gain) of dorsomedian trunk tubercles, a common character present in most species of *Ammothea*, is the only other character differentiating *Sericosura* from *Ammothea*, but this is perhaps a secondary loss and is not unique among known *Ammothea* species. As noted above, dorsomedian trunk tubercles might have been a secondary gain in *Ammothea*, but they are taller or otherwise more marked in many juvenile specimens of the genus. The two species of *Sericosura* lack them.

There are many questions concerning the presence of pycnogonids at hydrothermal vents and the very few answers are almost entirely conjectural. This is due in large part to our lack of even rudimentary knowledge of life histories and habits of most pycnogonids. We know very little of food and habitat preference and there has been no study, to my knowledge, of egg size and fecundity as a function of the duration and number of larval stages. The details of these life habits are simply not available to us.

The extremely tiny egg size of both of these species would suggest shorter embryonic and protonymphon stages with an increased number of juvenile stages similar to those of decapod crustaceans (Van Dover et al. 1985:223). Egg size is seldom noted in pycnogonid reports, but among those species figured with eggs attached to the male ovigers, the egg size generally appears to be equal to at least half or as much as the full diameter of the oviger segments on which they are strung. This excludes some of the callipallenid genera and species and some of the *Nymphon* species which have what

could be called giant eggs full of yolk. The eggs of *Ammothea verenae* are slightly larger than those of *Sericosura venticola*, in terms of the oviger segment size of each, but both egg sizes are sufficiently small to suggest a single pattern of abbreviated early development stages possibly related to hydrothermal vent-related habitats. The complete life history of so few pycnogonids is known with any certainty that it would be futile to speculate as to whether or not this abbreviated pattern with more juvenile stages is the exception to usual embryonic development or is the more normal course of events taken by the majority of pycnogonids.

Another question begging an answer in relation to hydrothermal vent-associated pycnogonids concerns the nature of food available to them. Pycnogonids are often found associated with sessile coelenterates from which they extract body juices with their suctorial proboscis. What sessile organisms are available in association with hydrothermal vents that are suitable for this suctorial form of extraction? The organisms most available appear to be vestimentiferans, palm worms, and vent-associated bacteria. There is nothing in hydrothermal vent-related literature, particularly in that of the Juan de Fuca Ridge, suggesting a prevalence of any form of sessile coelenterates at vents, but there is a form of mucus comprising a considerable portion of the total biomass (Tunnicliffe et al. 1985:459, 461) which, although low in organic content (less than 13% while containing 66.8% sulphur), could form a substantial part of the pycnogonid diet. Examination of the gut content of several specimens of *Ammothea verenae* was inconclusive, although what appeared to be small groups of bacteria were present. This evidence could be due to the ingestion of ubiquitous bacteria fortuitously, sulphur-oxidizing bacteria being present in almost all vent situations. No parts or recognizable tissues from worms were identified in the gut contents, although this does not rule out

their ingestion. From the slight evidence available, no conclusive proof can therefore be discovered concerning the diet, or indeed, the life habits of these two vent-associated species.

Acknowledgments

The specimens are deposited in the National Museum of Natural History, Smithsonian Institution, under the catalog numbers of the U.S. National Museum (USNM), the National Museum of Canada, Ottawa (NMC), and in the University of Victoria, Victoria, British Columbia (UVBC).

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